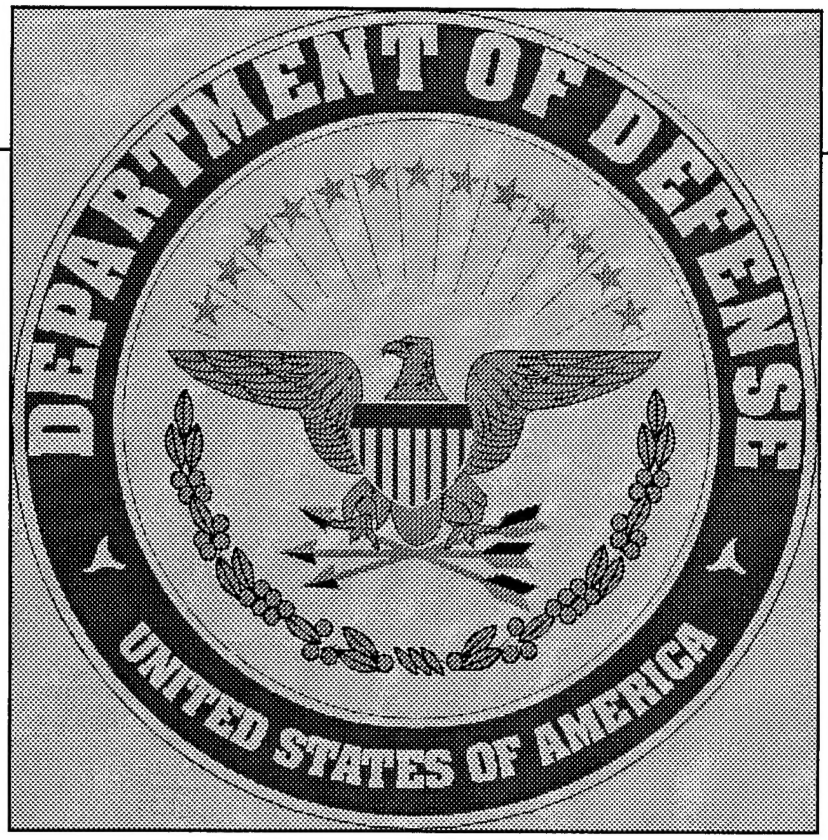

CAIS STANDARD MANUAL

SYSTEM NO. 1
BUILDING
SUBSTRUCTURE

CAS PROJECT
CAIS MANUAL

Issued April 28, 1995

8 Mar 96

MEMORANDUM FOR DTIC-OCP
ATTN: Ms. Lue Lynch
8725 John J. Kingman Road, Suite 0944
Fort Belvoir, VA 22060-6218

FROM: AL/EQ (STINFO)
139 Barnes Drive. Suite 2
Tyndall AFB FL 32403-5323

SUBJECT: Transmision of Technical Documents

1. As per telephone conversation with Andrew Poulis, EQ/TIC, the attached CAIS CTDS manuals are forwarded for accession, cataloging, and microconversions. Please forward the accession numbers to:

Andrew Poulis
AL/EQ/TIC
139 Barnes Drive. Suite 2
Tyndall AFB, FL 32403-5323

2. The Distribution statement should read as follows: Approved for Public Release: Distribution Unlimited.

3. If you have questions about these documents, please contact Andrew Poulis at DSN 523-6285.

Larry L. Testerman
LARRY L. TESTERMAN
Scientific and Technical
Information Program Manager

Atchs: Manuals

01 BUILDING SUBSTRUCTURE

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01 BUILDING SUBSTRUCTURE

ABSTRACT

GENERAL ORGANIZATION

At this installation the list of facilities to be surveyed will be addressed on the basis of 32 unique systems that form the CAIS Engineering Deficiency Standards and Inspection Methods document. Each system deals with a specific technical aspect of the facility to be surveyed. Within each system a further breakdown is made to subsystems, each having a specific list of components. Specific observations of the listed defects are provided so as to allow the entry of observed quantification data. A DOD CAIS manual is provided for each of the 32 systems with an internal organization as outlined below:

INSPECTOR'S GUIDE

I. General
   - A. Level I Inspection Method Description
   - B. Level II Inspection Method Description
   - C. Level III Inspection Method Description

II. General Inspection
   - A. Process. This section describes the process of the inspection activity.
   - B. Location. This section describes the procedure for locating the inspection units in the facility or infrastructure on this installation.

III. Inspector Qualifications
   This section notes the minimum qualifications for the person or persons performing the survey.

IV. Inspection Unit
   This section describes how the IU (Inspection Unit) is determined for the particular component being surveyed.

V. Unit Costs
   This section notes the nature of repair costs for this system.

VI. Standard Safety Requirements
   This section lists safety procedures and equipment required to implement a safe environment for the conduct of this survey.

VII. Standard Tools
   This section lists a set of standard tools required for the general conduct of this survey.

VIII. Special Tools and Equipment Requirements
   This section refers to special tools or equipment requirements endemic to the nature of the system being surveyed.

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IX. Level II Inspection Method Keys
This section explains the use of keys as they relate to Level II Guide Sheets.

X. Level III Inspection Method Keys
This section explains the use of keys as they relate to Level III Guide Sheets.

XI. Replacement Cost
This section describes the nature and location of replacement cost data.

XII. Appendices
Appendix A. Provides a listing and definition of all abbreviations used both in the Standards and in the data base.

Appendix B. Provides a glossary of terms with their definitions as used in the Standard.

Appendix C. This section contains a listing of the average life cycle durations for each assembly* in the Standard.

* Assembly is a term describing the level at which replacement rather than repair occurs. This can be at the subsystem or component designation, depending on the system being surveyed.

SYSTEM TREE

The System Tree is a graphical representation of the Work Breakdown Structure, showing system, subsystem and component relationships for the Building Substructure System.

INSPECTION METHODS

Description
Describes the nature of what is to be condition surveyed.

Special Tool and Equipment Requirements
Lists any special tools required for this specific subsystem.

Special Safety Requirements
This section outlines any special safety measures or equipment required for this specific subsystem so as to maintain a safe environment and process in the conduct of the condition survey.

Component List
All components to be surveyed under this subsystem are listed here.

Related Subsystems
All other subsystems that have a survey relationship to this subsystem are listed here to help coordinate a complete and thorough condition assessment survey.

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Standard Inspection Procedure

This statement indicates the various levels of survey effort required for this subsystem.

Components

The previously listed components of this subsystem are described with a survey procedure recommended on a component by component basis. For each component there is a listing of defects with each defect broken down into observations describing the nature and severity of the defective condition observed. The surveyor enters a quantification value for each defect/observation encountered in the field CAIS device (DCD) to record the result of his survey.

References

This page lists the reference sources from which the foregoing subsystem data was developed.

Guide Sheet Control Number

This section lists the key numbers that tie the written Level II and Level III guide sheets to specific components in this subsystem.

Level II and Level III Inspection Method Guide Sheets

This section contains the detailed descriptions of the Level II and III survey and inspection procedures for this subsystem.

01 BUILDING SUBSTRUCTURE

INSPECTOR'S GUIDE

I. GENERAL

A. Level I Inspection Method

The Level I Inspection Method of building substructure systems consists of a thorough inspection of each subsystem and component as described in the Work Breakdown Structure. Only readily accessible components need to be addressed during a Level I inspection. Portions of the system may be below grade and inaccessible during the Level I inspection. The survey activity is designed to be performed by a single surveyor.

B. Level II Inspection Method

Level II inspections are triggered by defect/observations noted at the Level I inspection or in some cases, are required to conduct a meaningful survey of the component being inspected. There are very few Level II inspections, since most defects are readily apparent from a Level I. Wood structures may require additional cleaning and probing to determine the quantity and level of severity for the defects identified in a Level I. Level II inspections are referenced by defect/observations through a "Level II key", which denotes a specific Guide Sheet that describes the Level II inspection activity.

C. Level III Inspection Method

The Level III inspection is triggered by defect/observations occurring in the Level I and II inspections. The Level III inspection can also occur as a result of time based scheduling, antidotal experience, or component age compared to its life cycle. The Level III inspection is referenced through a Level III key which in turn, denotes a specific Guide Sheet describing the Level III inspection process and requirements. Level III inspections produce a detailed, written engineering assessment of the deficiency along with an estimated cost of correction, and are performed at the option of the Facility Manager.

II. GENERAL INSPECTION

A. Process

Surveys are normally conducted at the component level. Figure 01-A provides the breakdown from system through component for the Building Substructure System. The surveyor will work through the Work Breakdown Structure (WBS) to conduct the inspection. At the component level the surveyor will be provided a list of defects, each of which is described further in detail as observations. These observations are described to various levels of severity as they relate to the effect of the life of the system. The quantification of each deficiency is identified by the surveyor using the associated unit of measure. Once an observation is populated with a deficient quantity, the inspector will be requested to provide information on the component type and location. The installation date or age of the component may be preloaded into the

01 BUILDING SUBSTRUCTURE

WBS for each asset from the Real Property Inventory List or site specific information. If necessary, age data can be overridden by the surveyor, Site CAIS personnel, or the Facility Manager.

B. Location

Level I and II inspections will be located by the surveyor through a discrete entry in the Field CAIS. Building floor plans or sketches are required to ensure a complete inspection of all areas and to assist in the location of IU's. The inspection team members must use the recommended room numbering schemes for the installation. The installation may have rooms physically identified by a numbering system or identified on floor plans. If both exist and are different, the Facility Manager will develop guidance on which numbering system takes precedence. Where numbering systems do not exist or are not complete in identifying each space, specific guidance for the inspector to annotate areas in a consistent manner should be developed by the Facility Manager and implemented in the installations CAS process. In all cases, plans and maps shall be orientated with the top of each sheet being the north direction, so as to allow directional location and description. In the case where no other means of location exist the inspector shall enter a brief (65 character) description of location. Locations must be accurate to insure future repeatability and consistent results.

III. INSPECTOR QUALIFICATIONS

The minimum inspector qualification for the Building Substructure System requires a five year journeyman. All of the condition survey requirements for this system can be accomplished at the Level I inspection by a single inspector, however, safety and other considerations may require that inspectors work in teams. Inspectors will be specifically trained in the CAS system and its usage and will be CAS certified in the "Civil" discipline.

IV. INSPECTION UNIT (IU)

The Inspection Unit (IU) is normally defined at the component level for this system. If the inspector finds multiple defects that occur on the same IU, the inspector will quantify the observation that is considered most severe and identify the remaining quantity under the less severe observation for the discrete component. Every IU relating to the Building Substructure System will be measured in square feet. The boundaries of each IU will be defined by some man-made break in the continuity of the material being inspected. The following list describes some typical examples:

- Slab-on-grade, bases, and pit IU's will be defined by expansion joints, wall intersections or any other man-made termination. If no expansion joints exist, the IU will be the total square footage of the surface within the room being inspected.

- A foundation wall IU will be defined by expansion joints, structural supports, floors, ceilings or any other directional change in the plane of the wall.

01 BUILDING SUBSTRUCTURE

- A foundation pier IU will be defined by the total square footage of the pier surface exposed to the inspector's vision.

V. UNIT COSTS

The unit costs that are applied to the quantities recorded for each observation are contained within the Site CAIS as repair cost.

VI. STANDARD SAFETY REQUIREMENTS

The Master Safety Plan will be followed at all times during the condition survey.

Inspector may utilize the following protective gear:

- Hard hat - to be worn during all surveys
- Safety glasses - to be worn during all surveys
- Safety shoes - to be worn during all surveys
- Coveralls - to be worn as necessary
- Gloves - to be worn as necessary
- Ear plugs - to be worn in designated areas
- Knee pads - to be worn when crawling is required
- Rain suit - to be worn as necessary
- Wet suit - to be worn as necessary

VII. STANDARD TOOLS

Employee Identification Card - to be worn or carried during all survey activities
Data Collection Device (DCD)
Battery pack for DCD
Flashlight
Tape measure - 20' (or other supplemental measuring devices)
Screwdrivers - Phillips and straight slot
Pliers
Pocket knife or ice pick
Scraper
Wire brush
Hammer (for sounding)
Calipers
Measuring scales

01 BUILDING SUBSTRUCTURE

VIII. SPECIAL TOOLS AND EQUIPMENT REQUIREMENTS

At the subsystem level, the deficiency standard has identified special tools and equipment required for the standard inspection of the associated components, which exceed the standard tools identified for the system. Level III Inspection Method Guide Sheets will address additional tools and equipment requirements that are specific to that particular advanced method of inspection.

Facility Managers should review these sections in order to determine any special tool requirements for subsystems they are to inspect/survey.

IX. LEVEL II INSPECTION METHOD KEYS

Certain observations will reference a Level II Inspection Method. The Facility Manager will be able to identify deficiencies where a Level II inspection is flagged. The Level II key at the observation level will refer to a specific guide sheet.

All Level II Guide Sheets are located at the end of each Subsystem section. A Guide Sheet Reference page precedes Level II and Level III Guide Sheets.

X. LEVEL III INSPECTION METHOD KEYS

Certain observations will trigger a Level III inspection. The Facility Manager will be able to identify deficiencies where a Level III inspection is flagged. The Level III Key at the observation level will refer to a specific guide sheet. These guide sheets may refer the Facility Manager to a more sophisticated and costly test method.

All Level III Guide Sheets are located at the end of each Subsystem section. A Guide Sheet Reference page precedes Level II and Level III Guide Sheets.

XI. REPLACEMENT COST

A replacement cost for each subsystem type will be contained within the cost estimating system in the Site CAIS.

XII. APPENDICES

Appendix A - Abbreviations

A summary and definition of all abbreviations used in this system are contained in Appendix A which is located at the end of Building Substructure.

Appendix B - Glossary

A glossary of terms used in this system are contained in Appendix B which is located at the end of Building Substructure.

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Appendix C - Life Cycles

A listing of the average life cycle duration for each assembly* in the Standard.

Note - Facility Manager's Guide

The following are included in the Facility Manager's Guide:

A table showing the required manhours to perform the standard inspection for this facility listed by Cat Code (three digit).

A listing of all Level III inspections with their estimated cost and time to perform. This list will include frequency of inspections for time driven Level III's.

* Assembly is a term describing the level at which replacement rather than repair occurs. This can be at the subsystem or component designation, depending on the system being surveyed.

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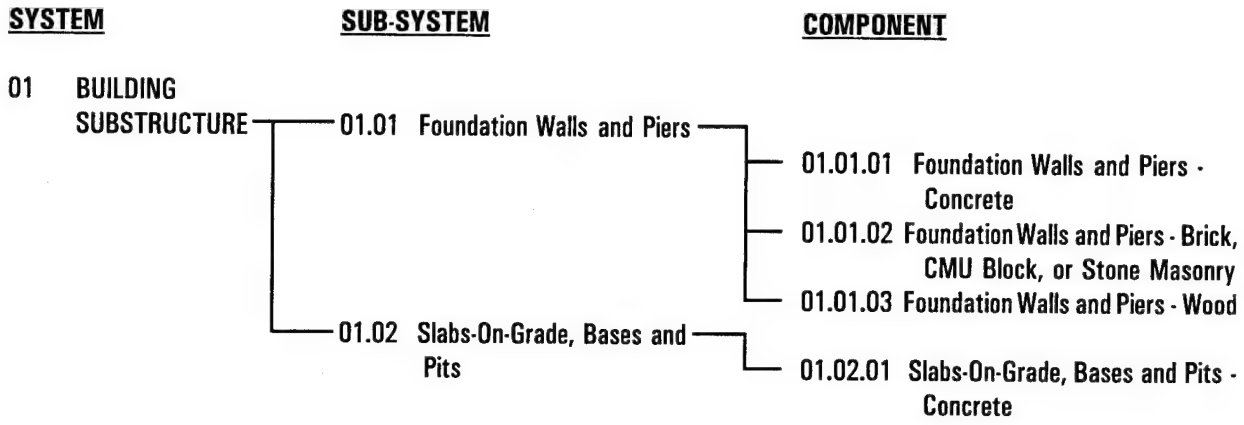
Figure 01-A. WORK BREAKDOWN STRUCTURE



01.01 FOUNDATION WALLS AND PIERS

DESCRIPTION

Foundation Walls and Piers is a subsystem of the Substructure System. They are part of the structural foundation. Foundation walls may also form a retaining wall for the below grade portion of the building. Foundation walls and piers transfer structural loads to the footings, which in turn transmit building loads to the earth below.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following special tools and equipment, beyond the requirements listed in the Standard Tool Section, are needed to perform the inspection of Foundation Walls and Piers:

1. Scraper
2. Wire Brush
3. Ice pick or pocket knife
4. Hammer
5. Calipers
6. Measuring scales

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of Foundation Walls and Piers, beyond the requirements listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- ◆ 01.01.01 FOUNDATION WALLS AND PIERS - CONCRETE
- ◆ 01.01.02 FOUNDATION WALLS AND PIERS - BRICK, CMU BLOCK, OR STONE MASONRY
- ◆ 01.01.03 FOUNDATION WALLS AND PIERS - WOOD

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

01.02 SLABS-ON-GRADE, BASES AND PITS

01.01 FOUNDATION WALLS AND PIERS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspections as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time. Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

COMPONENTS

◆ 01.01.01 FOUNDATION WALLS AND PIERS - CONCRETE

Exposed exterior and interior sides of the foundation walls and all accessible piers shall be inspected. Scaling is usually a finish or curing defect while spalling is a stress defect. Cracking may be the result of either of the above.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Cracking.**			
Observation:			
a. Open cracks, up to 1/16" wide.	LF		
*** {Severity M}			
b. Open cracks, greater than 1/16" in width or exceeding 2" in depth.	LF		1
*** {Severity H}			
*** Reinforcing steel corrosion.**			
Observation:			
a. Rusting/discoloration evident, cracks occurring parallel to reinforcement.	SF		2
*** {Severity H}			
b. Exposure of reinforcing steel.	SF		2
*** {Severity H}			
*** Out of plumb.**			
Observation:			
a. Greater than 3" in 10'.	SF		3
*** {Severity H}			
b. 1" to 3" in 10'.	SF		
*** {Severity M}			

01.01 FOUNDATION WALLS AND PIERS

COMPONENTS (Continued)

◆ 01.01.01 FOUNDATION WALLS AND PIERS - CONCRETE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Stucco surface defects.**			
Observation:			
a. Cracked/loose areas of stucco surface.	SF		
*** {Severity M}			
b. Scaling areas of stucco surface.	SF		
*** {Severity H}			
*** Deteriorated joint sealant/caulk.**			
Observation:			
a. Cracked joint sealant/caulk.	LF		
*** {Severity L}			
b. Separated/missing joint sealant/caulk.	LF		
*** {Severity H}			
*** Moisture on the interior surface of the foundation wall.**			
Observation:			
a. Visible moisture on interior wall area.	SF		
*** {Severity M}			
b. Water droplets on interior wall area.	SF		4
*** {Severity H}			
*** Excavation/backfill defects.**			
Observation:			
a. Ponding, standing water, depression, or erosion adjacent to foundation wall.	SF		
*** {Severity M}			
*** Missing or damaged insulation.**			
Observation:			
a. Damaged areas of insulation.	SF		
*** {Severity M}			
b. Missing areas of insulation.	SF		
*** {Severity H}			

01.01 FOUNDATION WALLS AND PIERS

COMPONENTS (Continued)

◆ 01.01.01 FOUNDATION WALLS AND PIERS - CONCRETE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Vertical displacement.**			
Observation:			
a. Variation from level less than 1".	SF		
*** {Severity L}			
b. Variation from level 1" to 2".	SF		
*** {Severity M}			
c. Variation from level of more than 2".	SF		
*** {Severity H}			
*** Scaling and spalling.**			
Observation:			
a. Scaling of surface up to 1/4" deep, with exposure of coarse aggregates.	SF		
*** {Severity L}			
b. Scaling of surface from 1/4" to 1/2" deep with coarse aggregates clearly exposed.	SF		
*** {Severity M}			
c. Spalling more than 1" deep, in beam or column - not at joint or juncture.	SF		1
*** {Severity M}			
d. Scaling of surface exceeding 1/2" deep.	SF		
*** {Severity H}			
e. Spalling more than 1" deep, in beam or column - at joint or juncture.	SF		1
*** {Severity H}			

01.01 FOUNDATION WALLS AND PIERS

COMPONENTS (Continued)

◆ 01.01.02 FOUNDATION WALLS AND PIERS - BRICK, CMU BLOCK, OR STONE MASONRY

Brick foundation walls contain "face brick" (brick placed on the exposed face of the wall) and "back-up brick" (brick placed behind the face brick). The brick, stone, or large stone aggregate facing panels can also be installed on concrete or CMU block foundation walls. Natural stone is used for stone masonry walls. Rubble stone masonry uses the stones in their natural state without shaping while ashlar masonry squares the faces of stones to be placed in surface positions. Both rubble and ashlar work may be either coursed or random. Brick, CMU block, or stone piers may be used to provide intermediate structural support for the floor system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged bricks, CMU, or stones.**			
Observation:			
a. Cracked, split or damaged.	SF		5
*** {Severity M}			
b. Loose or missing.	SF		5
*** {Severity H}			
*** Deteriorated mortar joint material.**			
Observation:			
a. Cracked mortar joint material.	LF		
*** {Severity L}			
b. Loose/missing mortar joint material.	LF		
*** {Severity H}			
*** Out of plumb.**			
Observation:			
a. Greater than 3" in 10'.	SF		6
*** {Severity H}			
b. 1" to 3" in 10'.	SF		
*** {Severity M}			
*** Stucco surface defects.**			
Observation:			
a. Cracked/loose areas of stucco surface.	SF		
*** {Severity M}			
b. Scaling or spalling areas of stucco surface.	SF		
*** {Severity H}			

01.01 FOUNDATION WALLS AND PIERS

COMPONENTS (Continued)

◆ **01.01.02 FOUNDATION WALLS AND PIERS - BRICK, CMU BLOCK, OR STONE MASONRY (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Moisture on the interior surface of the foundation wall.**			
Observation:			
a. Visible moisture on interior wall area.	SF		
*** {Severity M}			
b. Water droplets on interior wall area.	SF		7
*** {Severity H}			
*** Excavation/backfill defects.**			
Observation:			
a. Ponding, standing water, depression, or erosion adjacent to foundation wall.	SF		
*** {Severity M}			
*** Missing or damaged insulation.**			
Observation:			
a. Damaged areas of insulation.	SF		
*** {Severity M}			
b. Missing areas of insulation.	SF		
*** {Severity H}			
*** Vertical displacement.**			
Observation:			
a. Variation from level less than 1".	SF		
*** {Severity L}			
b. Variation from level 1" to 2".	SF		
*** {Severity M}			
c. Variation from level of more than 2".	SF		
*** {Severity H}			

01.01 FOUNDATION WALLS AND PIERS

COMPONENTS (Continued)

◆ 01.01.03 FOUNDATION WALLS AND PIERS - WOOD

The all weather wood foundation system uses a plywood sheathed, wood stud assembly for foundations and basements. Wood timbers may be used to provide intermediate structural support for the floor system.

Treated-wood footing planks are placed directly on an aggregate bed to serve as the base support for the basement walls. Wall sections are framed from studs end-nailed to top and bottom plates. Treated plywood sheathing is then nailed to the studs to form the basement envelope.

Joints between plywood wall panels are caulked, and a polyethylene vapor barrier is installed below grade on the exterior side of the wall sheeting. Inside, a concrete slab is cast on top of the aggregate bed. This slab becomes a structural element in the plywood system because it holds the toe of the wall in place against outside earth pressures.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Out of plumb.**			
Observation:			
a. Less than or equal to 3" in 10'.	SF		8
*** {Severity M}			
b. Greater than 3" in 10'.	SF		8
*** {Severity H}			
*** Rot, fungus or decay.**			
Observation:			
a. Moist stained area.	SF		
*** {Severity M}			
b. Soft or crushed area.	SF	1	9
*** {Severity H}			
*** Parasite damage.**			
Observation:			
a. Holes less than 1/8" diameter, surface sag, and frass observed.	SF	1	9
*** {Severity M}			
b. Holes greater than 1/8" diameter, surface channels, punctures, and crushing.	SF	1	9
*** {Severity H}			

01.01 FOUNDATION WALLS AND PIERS

COMPONENTS (Continued)

◆ 01.01.03 FOUNDATION WALLS AND PIERS - WOOD (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective connectors/anchorage.**			
Observation:			
a. Loose wood at connection.	EA		
*** {Severity M}			
b. Broken, split, or damaged wood at connection.	EA		
*** {Severity H}			
c. Missing/deteriorated fasteners or anchorage.	EA		
*** {Severity H}			
*** Moisture on the interior surface of the foundation wall.**			
Observation:			
a. Visible moisture on interior wall area.	SF		
*** {Severity M}			
b. Water droplets on interior wall area.	SF		10
*** {Severity H}			
*** Excavation/backfill defects.**			
Observation:			
a. Ponding, standing water, depression, or erosion adjacent to foundation wall.	SF		
*** {Severity M}			
*** Missing or damaged insulation.**			
Observation:			
a. Damaged areas of insulation.	SF		
*** {Severity M}			
b. Missing areas of insulation.	SF		
*** {Severity H}			
*** Vertical Displacement.**			
Observation:			
a. Variation from level less than 1".	SF		
*** {Severity L}			
b. Variation from level 1" to 2".	SF		
*** {Severity M}			
c. Variation from level of more than 2".	SF		
*** {Severity H}			

01.01 FOUNDATION WALLS AND PIERS

COMPONENTS (Continued)

◆ 01.01.03 FOUNDATION WALLS AND PIERS - WOOD (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Cracked, or broken foundation walls.**			
Observation:			
a. Less than 25 percent of thickness affected.	SF		
*** {Severity M}			
b. Greater than 25 percent of thickness affected.	SF		
*** {Severity H}			
c. Broken or deflected.	SF		
*** {Severity H}			

01.01 FOUNDATION WALLS AND PIERS

REFERENCES

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. NAVFAC MO-312, Wood Protection, 1990
3. Means Concrete Repair and Maintenance, Peter H. Emmons, 1994

01.01 FOUNDATION WALLS AND PIERS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 01.01.03-1

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 01.01.01-1
2	GS-III 01.01.01-2
3	GS-III 01.01.01-3
4	GS-III 01.01.01-4
5	GS-III 01.01.02-5
6	GS-III 01.01.02-6
7	GS-III 01.01.02-7
8	GS-III 01.01.03-8
9	GS-III 01.01.03-9
10	GS-III 01.01.03-10

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: FOUNDATION WALLS AND PIERS - WOOD
CONTROL NUMBER: GS-II 01.01.03-1

Application

This guide applies to the investigation of deterioration of wood foundation walls and piers structures due to rot, fungus, decay or parasite damage.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Clean affected area using scraper and brush.
2. Utilize calipers and scales to determine an approximation of the area that has been lost due to deterioration.
3. Tap with hammer in order to detect loss of interior material, evidenced by a hollow sound.
4. Probe with ice pick/pocket knife to determine extent of damage due to insect infestation, rot or fungi damage.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. NAVFAC MO-312, Wood Protection, 1990

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: FOUNDATION WALLS AND PIERS - CONCRETE
CONTROL NUMBER: GS-III 01.01.01-1

Application

This guide applies to the investigation of cracks and spalling in concrete foundation walls and piers, by a structural engineer/specialist.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Inspect defect to determine the extent and severity of damage and if further test are required at this time:
   a. Check general appearance for any conditions that may cause cracking or surface deterioration.
   b. Examine cracking to determine if cracks are active or dormant. Document the location, pattern, depth, width and length.
   c. Perform NDT, such as ultrasonic pulse velocity inspection of the cracks to determine extent of subsurface damage.
   d. If footings are exposed, examine for cracks or breaks and take core samples for lab analysis to determine condition or strength of the footing. Plug core holes with epoxy sealer after boring.
2. Document findings and forward to appropriate authority.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment
2. Concrete/masonry core boring equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, Peter H. Emmons, 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: FOUNDATION WALLS AND PIERS - CONCRETE
CONTROL NUMBER: GS-III 01.01.01-2

Application

This guide applies to the investigation of corrosion of reinforcing steel in concrete foundation walls and piers, by a structural engineer/specialist.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Inspect defect to determine extent and severity of damage and if further test are required at this time:
   a. Check for exposure and environment conditions, especially chemical attack. Document conditions.
   b. Check for improper design or construction conditions for inadequate concrete cover to protect it from corrosion. Document location and thickness of cover.
   c. Perform NDT to determine corrosion activity, such as a copper sulfate half-cell. These readings are taken on a grid basis and converted into potential gradient mapping.
2. Document findings and forward to appropriate authority.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Half-cell test equipment.

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, Peter H. Emmons, 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: FOUNDATION WALLS AND PIERS - CONCRETE
CONTROL NUMBER: GS-III 01.01.01-3

Application

This guide applies to the investigation of bowed or leaning concrete foundation walls, by a structural engineer/specialist.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Inspect defect to determine extent and severity of damage and if further test are required at this time:
   a. Check for uneven settlement by observing condition of exterior grade or foundation slab.
   b. Investigate past history of leak repair which can signify hydrostatic pressures creating bulging settlement.
   c. Check all sealant, expansion/contraction joints for deterioration which can allow water penetration.
   d. Perform NDT, such as ultrasonic pulse velocity test to compare structural integrity from one part of the wall to another and identify locations of cracks, breaks and other subsurface disintegration that could contribute to out of level or out of plumb condition.
2. Document findings and forward to appropriate authority.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, Peter H. Emmons, 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: FOUNDATION WALLS AND PIERS - CONCRETE
CONTROL NUMBER: GS-III 01.01.01-4

Application

This guide applies to the investigation of failed dampproofing/waterproofing systems in concrete foundation walls, by a structural engineer/specialist.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Inspect defect to determine extent and severity of damage and if further test are required at this time.
   a. From inside, locate area of dampness or leaks.
   b. If no cracks are visible, perform an ultrasonic pulse velocity test to locate cracks in concrete.
   c. Excavate in location of defect to expose exterior wall surface.
   d. Visually inspect barrier system and locate leaks, tears, breaks or disintegration.
2. Document findings and forward to appropriate authority.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment.
2. Back hoe, 40-45 HP, 5/8 CY capacity.

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, Peter H. Emmons, 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: FOUNDATION WALLS AND PIERS - BRICK, CMU BLOCK OR STONE MASONRY
CONTROL NUMBER: GS-III 01.01.02-5

Application

This guide applies to the investigation of cracks in brick, CMU or stone masonry foundation walls and piers, by a structural engineer/specialist.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Inspect defect to determine extent and severity of damage and if further test are required at this time:
   a. Check cracks for any stress related conditions, construction movement, settlement or overloads.
   b. Examine cracking to determine if cracks are active or dormant. Document the location, pattern, depth, width and displacement.
   c. Perform NDT to determine extent of internal cracking and discontinuities, such as ultrasonic pulse velocity inspection.
   d. If footings are exposed, examine for cracks or breaks and take core samples for lab analysis to determine condition or strength of the footing. Plug core holes with epoxy sealer after boring.
2. Document findings and forward to appropriate authority.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment
2. Concrete/masonry core boring equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6

COMPONENT: FOUNDATION WALLS AND PIERS - BRICK, CMU BLOCK OR STONE MASONRY

CONTROL NUMBER: GS-III 01.01.02-6

Application

This guide applies to the investigation of bowed or leaning brick, CMU block or stone masonry foundation walls, by a structural engineer/specialist.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Inspect defect to determine extent and severity of damage and if further test are required at this time:
   a. Check for uneven settlement by observing condition of exterior grade or foundation slab.
   b. Investigate past history of leak repair which can signify uneven hydrostatic pressures creating bulging settlement.
   c. Check all sealant, expansion/contraction joints or mortar joints for deterioration which can allow water penetration.
   d. Perform NDT, such as ultrasonic pulse velocity test to compare structural integrity from one part of the wall to another and identify locations of cracks, breaks and other subsurface disintegration that could contribute to bowed or leaning walls.
2. Document findings and forward to appropriate authority.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7

COMPONENT: FOUNDATION WALLS AND PIERS - BRICK, CMU BLOCK OR STONE MASONRY
CONTROL NUMBER: GS-III 01.01.02-7

Application

This guide applies to the investigation of failed dampproofing/waterproofing systems in brick, CMU block or stone masonry walls, by a structural engineer/specialist.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Inspect defect to determine extend and severity of damage and if additional test are required at this time:
   a. From inside, locate area of dampness or leaks.
   b. If no cracks are visible, perform an ultrasonic pulse velocity test to locate cracks in concrete.
   c. Excavate in location of defect to expose exterior wall surface.
   d. Visually inspect barrier system and locate leaks, tears, breaks or disintegration.
2. Document findings and forward to appropriate authority.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment.
2. Back hoe, 40-45 HP, 5/8 CY capacity.

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 8

COMPONENT: FOUNDATION WALLS AND PIERS - WOOD
CONTROL NUMBER: GS-III 01.01.03-8

Application

This guide applies to the investigation of out of level or out of plumb wood foundation walls and piers, by a structural engineer/specialist.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those listed in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Inspect defect to determine extent and severity of damage and if further test are required at this time:
   a. Sound with hammer.
   b. Bore or core (should be angled to prevent water accumulation). Plug hole with treated dowels. Examine core at the site and send to laboratory for biological studies.
   c. Test with a moisture meter.
   d. Check for uneven settlement by observing condition of surrounding exterior or foundation slab.
   e. Investigate past history of leak repair which can signify uneven hydrostatic pressures creating bulging settlement.
   f. Check all sealant, expansion/contraction joints or mortar joints for deterioration which will allow for water penetration.
2. Document findings and forward to appropriate authority.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. One-pound hammer
2. Increment borer
3. Moisture meter
4. Treated wood dowels

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 8 (Continued)

COMPONENT: FOUNDATION WALLS AND PIERS - WOOD (Continued)
CONTROL NUMBER: GS-III 01.01.03-8

References

1. NAVFAC MO-322, Vol. I and Vol. II, Inspection of Shore Facilities, 1993
2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
3. NAVFAC MO-312, Wood Protection, 1990

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 9

COMPONENT: FOUNDATION WALLS AND PIERS - WOOD
CONTROL NUMBER: GS-III 01.01.03-9

Application

This guide applies to the investigation of deterioration of wood foundation walls and piers due to rot, fungus, decay or parasites, by a structural engineer/specialist.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Inspect defect to determine extent and severity of damage and if further test are required at this time:
   a. Sound with hammer.
   b. Utilize ultrasonic pulse velocity test equipment to check for hidden or interior damage and the loss of material thickness.
   c. Utilize sample coring and in-situ surface hardness testing for lab analysis to determine the size, locations and areas of deterioration. Plug holes with treated wood plugs after boring.
2. Document findings and forward to appropriate authority.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment
2. Increment borers
3. Treated wood dowels

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. NAVFAC MO-312, Wood Protection, 1990

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 10

COMPONENT: FOUNDATION WALLS AND PIERS - WOOD
CONTROL NUMBER: GS-III 01.01.03-10

Application

This guide applies to the investigation of failed dampproofing/waterproofing systems in wood foundation walls, by a structural engineer/specialist.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Inspect defect to determine extent and severity of damage and if further test are required at this time:
   a. From inside, locate area of dampness or leaks.
   b. Excavate in location of defect to expose exterior wall surface.
   c. Visually inspect barrier system and locate leaks, tears, breaks or disintegration.
2. Document findings and forward to appropriate authority.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Back hoe, 40-45 HP, 5/8 CY capacity.

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, Peter H. Emmons, 1994

01.02 SLABS-ON-GRADE, BASES AND PITS

DESCRIPTION

Slabs-On-Grade, Bases and Pits is a subsystem of the Substructure System. Slabs-On-Grade, Bases and Pits are flat, horizontal (or nearly so), non-reinforced or reinforced slabs of concrete pumped or poured in forms over compacted granular fill such as gravel or crushed stone which has been covered by a polyethylene vapor barrier.

Concrete bases, both non-reinforced and reinforced, are constructed like small slabs-on-grade for the specific purpose of supporting structural components, equipment, individual objects, etc.

Concrete pits are below-grade structures constructed with reinforced concrete walls and slab footings. Pits are often used for installation and service of structural components and equipment.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Slabs-On-Grade, Bases and Pits, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of Slabs-On-Grade, Bases and Pits, beyond the requirements listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- 01.02.01 SLABS-ON-GRADE, BASES AND PITS - CONCRETE

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

01.01	FOUNDATION WALLS AND PIERS
02	BUILDING SUPERSTRUCTURE

01.02 SLABS-ON-GRADE, BASES AND PITS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspections as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time. Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

COMPONENTS

◆ 01.02.01 SLABS-ON-GRADE, BASES AND PITS - CONCRETE

Concrete bases may be non-reinforced or reinforced, depending on the load to be supported. Non-reinforced concrete slabs-on-grade are cast in place and thick enough to provide required strength. Reinforced concrete slabs-on-grade utilize welded wire mesh or reinforcing rods imbedded in the concrete to increase resistance to tensile and shear stresses.

Non-reinforced base units may be used as pads under light weight equipment such as transformers or heat units, while reinforced bases may be used to support building components, heavy equipment, etc.

Reinforced concrete pit walls and flooring are poured in place; thickness depends on angle of repose and weight of supported structures.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Cracking.**			
Observation:			
a. Open cracks, less than 1/16" wide.	LF		
*** {Severity M}			
b. Wide cracks, between 1/16" and 1/4" wide.	LF		1
*** {Severity H}			
c. Extensive disintegration of surface or cracks exceeding depth of 2".	SF		1
*** {Severity H}			
*** Reinforcing steel corrosion.**			
Observation:			
a. Rusting/discoloration evident, cracks occurring parallel to reinforcement.	SF		2
*** {Severity H}			
b. Exposure of reinforcing steel.	SF		2
*** {Severity H}			

01.02 SLABS-ON-GRADE, BASES AND PITS

COMPONENTS (Continued)

◆ **01.02.01 SLABS-ON-GRADE, BASES AND PITS - CONCRETE (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Popouts.**			
Observation:			
a. Conical holes less than 5/8" in diameter.	SF		
*** {Severity M}			
b. Conical holes greater than 5/8" in diameter.	SF		
*** {Severity H}			
*** Vertical displacement.**			
Observation:			
a. Variation from level less than 1".	SF		
*** {Severity L}			
b. Variation from level 1" to 2".	SF		
*** {Severity M}			
c. Variation from level of more than 2".	SF		
*** {Severity H}			
*** Sealant damage.**			
Observation:			
a. Deterioration evidenced by hardening of sealant/caulking.	LF		
*** {Severity M}			
b. Deterioration evidenced by shrinking, cracking or missing sealant/caulking.	LF		
*** {Severity H}			
*** Scaling and spalling.**			
Observation:			
a. Scaling of surface up to 1/4" deep, with exposure of coarse aggregates.	SF		
*** {Severity L}			
b. Scaling of surface from 1/4" to 1/2" deep, with coarse aggregates clearly exposed.	SF		
*** {Severity M}			
c. Spalling more than 1" deep.	SF		
*** {Severity M}			
d. Scaling of surface exceeding 1/2" deep.	SF		
*** {Severity H}			

01.02 SLABS-ON-GRADE, BASES AND PITS

REFERENCES

1. Means Concrete Repair and Maintenance, Peter H. Emmons, 1994

01.02 SLABS-ON-GRADE, BASES AND PITS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
N/A	

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 01.02.01-1
2	GS-III 01.02.01-2

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: SLABS-ON-GRADE, BASES AND PITS - CONCRETE
CONTROL NUMBER: GS-III 01.02.01-1

Application

This guide applies to the investigation of cracks in concrete slabs-on-grade, bases and pits, by a structural engineer/specialist.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Inspect defect to determine extent and severity of damage and if further test are requires at this time:
   a. Check general appearance for any conditions that may cause cracking or surface deterioration.
   b. Examine cracking to determine if cracks are active or dormant. Document the location, pattern, depth, width and length.
   c. Perform NDT, such as ultrasonic pulse velocity inspection of the cracks to determine extent of subsurface damage.
2. Document findings and forward to appropriate authority.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, Peter H. Emmons, 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: SLABS-ON-GRADE, BASES AND PITS - CONCRETE
CONTROL NUMBER: GS-III 01.02.01-2

Application

This guide applies to the investigation of corrosion of reinforcing steel in concrete slabs-on-grade, bases and pits, by a structural engineer/specialist.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Inspect defect to determine extent and severity of damage and if further test are required at this time:
   a. Check for exposure and environmental conditions, specifically chemical attack. Document conditions.
   b. Check for adequacy of concrete cover to protect it from corrosion.
   c. Perform NDT to determine corrosion activity, such as a copper sulfate half- cell. These readings are taken on a grid basis and converted into potential gradient mapping.
2. Document findings and forward findings to appropriate authority.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Half-cell test equipment.

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, Peter H. Emmons, 1994

APPENDIX A

ABBREVIATIONS

AIC	American Institute of Chemists
CAIS	Condition Assessment Information System.
CAS	Condition Assessment Survey
CERL	Construction Engineering Research Laboratory
CMU	Concrete Masonry Unit
CY	Cubic Yard
DCD	Data Collection Device
EA	Each
FT	Foot
GS	Guide Sheet
HR	Hour
I.E.	"That Is"
IU	Inspection Unit
LF	Linear Foot
N/A	Not Applicable
NAVFAC-MO	Naval Facilities Maintenance and Operations
NDT	Non-Destructive Testing
PE	Professional Engineer
PM	Preventive Maintenance
RPIL	Real Property Inventory List
SF	Square Foot
TM	Technical Manual

APPENDIX A

UOM	Unit Of Measurement
YRS	Years
WBS	Work Breakdown Structure
°	Degrees of Temperature
°C	Degrees Centigrade
°F	Degrees Fahrenheit
=	Equals
'	Feet
>	Greater Than
≥	Greater Than or Equal To
"	Inches
<	Less Than
≤	Less Than or Equal To
/	Per or Over
%	Percent
+	Plus or Positive or Add
±	Plus or Minus
–	Subtract or Minus or Negative
·	Times or By
x	Times or By

APPENDIX B

GLOSSARY

Aggregate	An inert granular material such as natural sand and gravel; which when bound together into a mass by a matrix forms concrete or mortar.
Anchorage	Devices used to attach the structural members to the building frame.
Ashlar	Squared building stone.
Backfill	Soil which is replaced in an area that has been excavated previously.
Bituminous	Having to do with a semisolid mixture of hydrocarbons derived from coal or petroleum, as coal-tar pitch or asphalt; before application, usually dissolved in a solvent, emulsified, or heated to a liquid state.
Core Samples	A cylindrical sample of a substrate obtained by means of a core barrel and drill.
Corrosion	The deterioration of metal or of concrete by chemical or electrochemical reaction resulting from exposure to weathering, moisture, or chemicals, or other agents in the environment in which it is placed.
Decay	A deterioration or decomposing as of vegetable matter.
Dielectric	A nonconductor of electricity; an insulator or insulating material.
Discontinuities	A lack of logical sequence; a gap or a break.
Displacement	The weight or volume of a fluid which otherwise would fill the space of a floating object. In structural terms the load of the building, if not properly engineered, can result in settlement of the structure; this settlement is the result of the displacement of soil by the foundation or footing of the building which is pushing aside the surrounding soil.
Footing	That portion of the foundation of a structure which transmits loads directly to the soil; used to spread the load over a greater area to prevent or reduce settling.

APPENDIX B

Foundation	Any part of a structure that serves to transmit the load to the earth or rock, usually below ground level; the entire masonry substructure.
Fungus	Any of a large group, including molds, mildews, mushrooms, rusts, and smuts, which are parasites on living organisms or feed upon dead organic material, lack chlorophyll, true roots, stems, leaves, and reproduce by means of spores.
Grade	The ground elevation or level, contemplated or existing, at the outside edge of a building, or elsewhere at the building site.
Half-Cell Test Equipment	In electrochemical cells, the electrical potential developed by the cell reaction; can be considered, for calculation purposes, as the sum of the potential developed at the anode and the potential developed at the cathode, each being a half-cell. This difference in potential can be detected by placing a copper/ copper sulfate half-cell on the surface of the concrete and measuring the potential differences between the reinforcing steel and a wet sponge on the concrete surface. The reference cell connects the concrete surface to a high-impedance voltmeter, which is also connected electrically to the reinforcing steel mat.
Increment Borer	A tool used to take samples of structural members made of wood. It consists of a tube with a sharpened end that is turned by use of a handle which pushes the tube into the wood cutting a sample which can be removed from the member; and analyzed for moisture or other parameters.
Level	A horizontal line or plane; especially such a plane taken as a basis for the measure of elevation.
Life Cycle	Under normal conditions, the expected life span based on proper installation and preventive maintenance.
Load	A force or system of forces, carried by a structure, or part of a structure.
Parasite	A plant or animal that lives on or in an organism of another species from which it derives sustenance or protection without benefitting the host and usually doing harm.
Pier	A heavy column, usually square, used to support weight as at the end of an arch. Also a reinforcing part built out from the surface of a wall.

APPENDIX B

Pit	An area below floor or ground level.
Plate	A thin, flat, sheet of material, or a timber laid horizontally on its widest side in a wall or on top of a wall or on the ground, to receive other timbers or joists.
Plumb	Exactly vertical.
Plywood	Structural wood made of three or more layers of veneer (usually an odd number), joined with glue; laid with the grain of adjoining plies at right angles.
Pop-Outs	A conical fragment that has broken out of the surface of the concrete leaving small holes. Generally a shattered aggregate particle will be found at the bottom of the hole, with a part of the fragment still adhering to the small end of the pop-out cone. Pop-outs are caused by reactive aggregates and high alkali cement. They are also caused by aggregates such as shale, which expand with moisture.
Rot	Decomposition in wood by fungi and other microorganisms; reduces the strength, density, and hardness.
Scaling	The gradual and continuing loss of surface mortar and aggregate over an area; due to the failure of the cement paste caused by chemical attack or freeze/thaw cycles.
Shear Stress	The force per unit area of cross section that tends to produce shear, which is a deformation (e.g. in a beam or flexural member) in which parallel planes slide relative to each other so as to remain parallel.
Sheathing	The covering (usually wood boards, plywood or wallboards) placed over exterior studding or rafters of a building; provides a base for the application of wall or roof cladding.
Slab	Either the level part of a reinforced concrete floor, which is carried on beams below. Or a concrete mat poured on subgrade, serving as a floor rather than as a structural member.
Spalling	A roughly circular or oval depression in the concrete. Spalls result from the separation and removal of a portion of the surface concrete, revealing a fracture roughly parallel to the surface. Spalls can be caused by corroding reinforcement steel and friction from thermal movement; reinforcing steel is often exposed.

APPENDIX B

Stucco	An exterior finish, usually textured; composed of portland cement, lime, and sand, which are mixed with water. Or a fine plaster for decorative work or moldings.
Studs	An upright post or support, especially one of a series of vertical structural members which act as the supporting elements in a wall or partition.
Tensile Stress	The stress per square unit area of the original cross section of a material which resists its elongation.
Toe	A projection from the foot or foot piece of any object or construction to give it broader bearing and greater stability. That part of a base of a concrete retaining wall which projects in front of the face of the wall, away from the retained material.
Ultrasonic Pulse Velocity Test	An ultrasonic detector is used either in scanning (non-contact) mode. The pulse velocity test uses the contact mode. A metal probe (transducer) supplied with the detector is stimulated by ultrasound and transmits the waves, when touched against equipment surfaces, to another detector. The velocity of this ultrasonic pulse is measured; the faster the pulse the more dense the material tested. The test can also detect and evaluate cracks, voids, delamination and other defects.

APPENDIX C

LIFE CYCLES

01 SUBSTRUCTURE

01.01 FOUNDATION WALLS AND PIERS

Concrete Foundation Walls and Piers	40 YRS
Brick Foundation Walls and Piers	30 YRS
CMU Block Foundation Walls and Piers	30 YRS
Stone Foundation Walls and Piers	40 YRS
Wood Foundation Walls and Piers	25 YRS

Source:
Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

01.02 SLABS-ON-GRADE, BASES AND PITS

Concrete	40 YRS

Source:
Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988